



ZB

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent Application of:
JONES et al.

Serial No.: 10/697,945
Filed: 10/31/03

Group: 3643
Examiner: COLLINS, Timothy D.

Title: AEROENGINE NACELLE

PRIORITY CLAIM SUBMISSION AND CERTIFIED COPY

Date: August 22, 2005

Hon. Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

It is respectfully requested that under the provisions of 35 USC 119/365, this application be given the benefit of the foreign filing date of the following, a certified copy of which is attached hereto:

Application No.
0315800.3
0312490.6

Country of Origin
Great Britain
Great Britain

Filed
7/7/03
6/2/03

Respectfully submitted,

[Signature]
W. Warren Taltavull
Reg. No. 25647

MANELLI DENISON & SELTER PLLC
2000 M Street N.W. Suite 700
Washington D.C. 20036
202 261 1047

THIS PAGE BLANK (USPTO)



INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., p.l.c. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

Dated 10 November 2003

**CERTIFIED COPY OF
PRIORITY DOCUMENT**

An Executive Agency of the Department of Trade and Industry

BEST AVAILABLE COPY

THIS PAGE BLANK (USPTO)

Patents Form 1/77

Agents Act 1977
(Rule 16)

THE PATENT OFFICE
LJ
- 2 JUN 2003
RECEIVED BY FAX



02JUN03 E811490-1 000370
P01/7700 0.00-0312490.6

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference
DY3157

2. Patent application number
(The Patent Office will fill in this part)

0312490.6

- 2 JUN 2003

3. Full name, address and postcode of the or of each applicant (underline all surnames)

ROLLS-ROYCE PLC
65 BUCKINGHAM GATE
LONDON
SW1E 6AT

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

ENGLAND

317 0002

4. Title of the invention
AEROENGINE NACELLE

5. Name of your agent (if you have one)

M A GUNN

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

ROLLS-ROYCE plc
PATENTS DEPARTMENT
PO BOX 31
DERBY
DE24 8BJ

Patents ADP number (if you know it)

397 0004

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number
(if you know it)

Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

YES

- a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description

	8
Claim(s)	1
Abstract	1
Drawing(s)	2

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

2

Request for preliminary examination and search (Patents Form 9/77)

1

Request for substantive examination (Patents Form 10/77)

1

Any other documents
(please specify)**DEPOSIT ACCOUNT FEE SHEET**

11.

I/We request the grant of a patent on the basis of this application.

Signature

Date

M A GUNN

2.6.2003

12. Name and daytime telephone number of person to contact in the United Kingdom

K A WHITE

01332 249452

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- Once you have filled in the form you must remember to sign and date it.
- For details of the fee and ways to pay please contact the Patent Office.

DUPLICATE

ROLLS-ROYCE plc

CASE NO: DY3157

RR TITLE: [REDACTED]

APPLICATION NO:

DATED: 2 JUNE 2003

FIRST APPLICATION

DRAFTED BY: KAW

PATENTS ACT 1977

SPECIFICATION

AEROENGINE NACELLE

1

AEROENGINE NACELLE

The present invention relates to a nacelle for a gas turbine engine and in particular a nacelle configuration comprising an openable thrust reverser unit to provide improved access to accessories mounted on a fan casing and a core engine.

A convention nacelle for a turbofan gas turbine engine comprises three major components: an intake, fan cowl doors and a thrust reverser unit. These turbofan engines also incorporate a fan containment system attached to an engine fan casing. The fan cowl doors are generally C-shaped that are each opened by a power opening system and hold-open rods for access to fan casing mounted accessories. The thrust reverser unit also comprises two generally C-shaped doors that are each opened by a further power opening system and hold-open rods for access to the core engine and other core mounted engine accessories.

This conventional arrangement is disadvantaged in that there are two independent power opening system and hold-open rods for the fan cowl doors and thrust reverser doors. Furthermore, the prior art nacelle comprises a joint between each section which leads to an undesirable disturbance in airflow over the nacelle inner and outer surfaces with resultant aerodynamic drag losses. This arrangement also requires substantial fire insulation material around the large fan casing chamber inward of the fan cowl doors. Thus the conventional arrangement is heavy and costly to manufacture and is disadvantaged by requiring two sets of doors to be opened for access to the engine.

Therefore it is an object of the present invention to provide a nacelle arrangement that reduces the number of openable doors, reduces weight of the assembly and reduces aerodynamic drag. These are accomplished by reducing the number of nacelle components to two, with primarily the fan cowl doors being integrated partially into the intake and

2

substantially into the thrust reverser unit. This arrangement also integrates the fan containment system into the nacelle intake removing the need for a bolted flange joint and reducing the size of the fan casing chamber fire zone. As the fan case accessory fire zone is reduced in size less fire extinguishing equipment, ventilation requirements and fire protection treatment is required.

The reduced number of steps or gaps between nacelle components, especially in the external nacelle surface reduces aerodynamic drag. Access to the fan case mounted accessories and core engine is simplified by provision of a single power opening system and hold open rods to the extended thrust reverser unit. The intake of the present invention extends further rearwards and provides an extended length for natural airflow and subsequent aerodynamic drag reduction. By integrating the fan containment casing into the intake, there is no bolted flanged joint forward of the fan system enabling provision for improved acoustic panels thus reducing engine-generated noise.

Accordingly the present invention seeks to provide a nacelle for a gas turbine engine, the engine comprising accessories mounted to a fan casing and a core engine, the nacelle substantially surrounds the engine and comprises an intake and a thrust reverser unit, the thrust reverser unit is formed by two generally C-shaped and openable portions characterised in that the thrust reverser unit is openable to provide access to the accessories and the core engine.

Preferably, the nacelle comprises a fan containment casing, the fan containment casing is integral with the intake.

Preferably, an acoustic panel extends between a downstream edge of the fan containment casing and a leading edge of the intake, thus reducing engine-generated noise.

Preferably, the fan containment casing is disposed outside a fire zone of the nacelle.

The present invention will be more fully described by way of example with reference to the accompanying drawings in which:

Figure 1 is a schematic section of part of a prior art nacelle surrounding a conventional fan gas turbine engine;

Figure 2 is a schematic section of part of a nacelle, in accordance with the present invention, surrounding a conventional fan gas turbine engine;

Figure 3 is an isometric view of a nacelle mounted to a wing and in accordance with the present invention.

With reference to Figures 1 and 2, a ducted fan gas turbine engine generally indicated at 10 has a principal and rotational axis 11. The engine 10 comprises, in axial flow series, an air intake 12, a propulsive fan 13, an intermediate pressure compressor 14, a high-pressure compressor 15, combustion equipment 16, a high-pressure turbine 17, and intermediate pressure turbine 18, a low-pressure turbine 19 and a core nozzle 20. A core duct 22 is partly defined radially inwardly by a core plug 23 and radially outwardly by the core nozzle 20.

The gas turbine engine 10 works in the conventional manner so that air entering the intake 11 is accelerated by the fan 13 to produce two air flows: a first air flow into the intermediate pressure compressor 14 and a second air flow which passes through a bypass duct 24 to provide propulsive thrust. The intermediate pressure compressor 14 compresses the air flow directed into it before delivering that air to the high pressure compressor 15 where further compression takes place.

The compressed air exhausted from the high-pressure compressor 15 is directed into the combustion equipment 16 where it is mixed with fuel and the mixture combusted. The resultant hot combustion products then expand through, and thereby drive the high, intermediate and low-pressure turbines 17, 18, 19 before being exhausted through the nozzle 20 to provide additional propulsive thrust. The

4

high, intermediate and low-pressure turbines 17, 18, 19 respectively drive the high and intermediate pressure compressors 15, 14 and the fan 13 by suitable interconnecting shafts 25, 26, 27.

5 A fan casing 28 circumferentially surrounds the fan 13 and an array of outlet guide vanes 29 and comprises a fan containment casing 33. The fan containment casing 33 surrounds the fan 13 and is attached to the fan casing 28 at a bolted flange joint 44'. The fan casing 28 is
10 supported by the annular array of outlet guide vanes 29. The fan casing 28 is used as a mount for some engine accessories 34 as known in the art.

Referring to Figure 1, a conventional nacelle 21 generally surrounds the engine 10 and comprises the intake
15 12, fan cowl doors 30, a thrust reverser unit 31 and a bypass exhaust nozzle 32. It is necessary to access the accessories 34 for maintenance and so fan cowl doors 30 are provided. Two generally C-shaped fan cowl doors 30 are rotatably mounted to a pylon suspended from a wing of an
20 associated aircraft and each are openable via a power opening system and hold open rods as known in the art. The fan cowl doors 30 are located via V-shaped groove joints 35, 36 to the intake 12 and thrust reverser unit 31 respectively. The fan cowl doors 30 and the fan casing 28
25 define a chamber 37 in which the engine accessories 34 are housed. The chamber 37 is a fire zone and must therefore be adequately sealed against fire escaping therefrom. The chamber 37 is provided with fire protection material that lines the chamber 37, fire extinguishing equipment and
30 suitable ventilation requirements. Such fire precautions are well known in the art and an example of which is the Rolls-Royce Trent 700 Aeroengine.

Rearward of the fan cowl doors 30, and located via radially outer and inner V-shaped groove joints 36 and 36'
35 to the downstream end of the fan casing 28, is the thrust reverser unit 31. The thrust reverser unit 31 comprises

5

radially inner and outer walls 38, 39 and housed therebetween a cascade structure 40 and a drive mechanism 41 for operation of the thrust reverser unit in thrust reversing mode. The drive mechanism 41 is mounted to the axially short member 52, which is attached to the fan casing at joint 36' and to fan cowl doors at joint 36. The outer wall 39 joins the axially short member 52, 52' at joint 46 and the inner wall at joint 46'.

The thrust reverser unit 31 further comprises bypass duct blocker doors 42, rotatably mounted at their upstream end to the inner wall 38 and at their downstream end to a rotatably mounted link 43. The operation of the thrust reverser unit 31 is well known and briefly comprises the drive mechanism 41 driving the radially inner and outer walls 38, 39 rearward to expose the cascade structure 40 to the airflow through the bypass duct 24, which is blocked by the blocker doors 42 having been swung radially inwardly by the rearward movement and the rotatable links 43.

It is necessary to access the core 9 of the engine to maintain other engine accessories 48 mounted on a core engine casing 49, the compressors 14, 15, turbines 16, 17, 18 and combustor equipment 16 and so the thrust reverser comprises two generally C-shaped portions that are rotatably mounted to a pylon suspended from a wing of an aircraft and are each openable via a power opening system and hold open rods as known in the art.

However, this conventional arrangement is disadvantaged in that there are two independent power opening systems and sets of hold-open rods for the fan cowl doors 30 and thrust reverser unit doors 31. Furthermore, the prior art nacelle 21 comprises joints 35, 35' and 36, 36' between each nacelle section (12, 30, 31) and further joints 46, 46' that cause undesirable breakdown in airflow over the nacelle inner and outer surfaces and subsequent aerodynamic drag losses. This arrangement also requires substantial fire insulation material within the large fan

6

casing chamber 37 inward of the fan cowl doors 30. Thus this conventional arrangement is also heavy and costly to manufacture and does not provide simple access for engine maintenance.

5 Referring now to Figures 2 and 3 where the engine 10 and its operation is substantially the same as described hereinbefore, a nacelle 55 in accordance with the present invention generally surrounds the engine 10 and comprises an intake 12 and a thrust reverser unit 31. The fan cowl
10 doors 30 of the prior art nacelle 21 have been removed and are replaced mainly by the radially outer wall 39 being extended forwards, thereby surrounding the fan casing 28, to meet with the rearward part of the intake 12 at joint 44, 44'. The intake 12 comprises the fan containment
15 casing 33 in an integral assembly. Therefore as shown in Figure 2 the tip 57 of each fan blade of the fan 13 is substantially parallel with the engine centre-line 11 to permit the intake 12 to be assembled to the fan casing 28.

The thrust reverser 31 of the present invention
20 comprises two generally C-shaped portions 31a, 31b that are rotatably mounted to a pylon 50 suspended from a wing 51 of an associated aircraft, and are each openable via a power opening system 53 and hold open rods 54 as known in the art. However briefly, the power opening system 53 is
25 rotatably mounted to the fan casing 28 and provides a force to open each C-shaped portions 31a, 31b, while the hold open rods 54 are manually fitted to provide a rigid support. Access to the engine accessories 34 and core engine 9, which includes the core accessories 48, is
30 therefore made simpler through this single set of thrust reverser C-shaped doors 31a, 31b.

It should be appreciated that the nacelle 55 arrangement of the present invention reduces the number of nacelle 55 components to two, with primarily the prior art
35 fan cowl doors 30 being integrated partially into the intake 12 and mainly into the thrust reverser unit 31.

7

This arrangement then integrates the fan containment system 33 into the intake 12 removing the joints 35, 35' and 36. Joint 36' remains in place between the radially inner wall 38 of the thrust reverser unit 31 and the rearward end of the fan casing 28. The joint 44, 44' is positioned rearward of the fan 13, which reduces the size of the fan casing chamber 37 fire zone. As this fan case accessory fire zone is reduced in size a reduced amount of fire extinguishing equipment, ventilation requirements and fire protection treatment is required making the nacelle assembly 55 lighter and cheaper than the prior art nacelle 21. Furthermore, reducing the number of joints reduces the number of steps or gaps between nacelle components, especially in the external nacelle surface which is beneficial in reducing aerodynamic drag and which allows an improved airflow to form over the radially inner and outer surfaces of the nacelle 55. Access to the fan case mounted accessories 34 and core engine 9 is simplified by provision of a single power opening system 53 and hold open rods 54 to open each C-shaped portion 31a, 31b of the thrust reverser unit 31. The intake 12 of the present invention extends further rearwards and provides an extended length for a smooth airflow to form and subsequent aerodynamic drag reduction. By integrating the fan containment casing 33 into the intake 12, there is no bolted flanged joint 35, 35' forward of the fan system 13. This enables substantially all of a radially inner surface 45 of the intake 12 to comprise acoustic panels 56 which extend between the downstream edge of the fan containment casing 33 and the leading edge of the intake 12, thus reducing engine-generated noise.

It should be appreciated by one skilled in the art that other forms of thrust reverser unit are interchangeable with the cascade structure/blocker door style arrangement described herein, whilst remaining within the scope of the present invention. Other thrust reverser

units include those described in and incorporated herein by reference to "The Jet Engine", Rolls-Royce Plc, 1986 pp159-167, and those others as known in the art, such as pivoting door type thrust reversers.

5 Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore
10 referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

Claims:

1. A nacelle (55) for a gas turbine engine (10), the engine (10) comprising accessories (34) mounted to a fan casing (28) and a core engine (9), the nacelle (55) substantially
5 surrounds the engine (10) and comprises an intake (12) and a thrust reverser unit (31), the thrust reverser unit (31) is formed by two generally C-shaped and openable portions 31a, 31b, characterised in that the thrust reverser unit (31) is openable to provide access to the accessories (34)
10 and the core engine (9).
2. A nacelle (55) as claimed in claim 1 wherein the nacelle (55) comprises a fan containment casing (33), the fan containment casing (33) is integral with the intake (12).
3. A nacelle (55) as claimed in claim 2 wherein the intake
15 (12) comprises an acoustic panel (45) that extend between a downstream edge of the fan containment casing (33) and a leading edge of the intake (12), thus reducing engine-generated noise.
4. A nacelle (55) as claimed in any one of claims 2-3
20 wherein the fan containment casing (33) is disposed outside a fire zone (37) of the nacelle (55).
5. A nacelle (55) substantially as described in this specification and with reference to and as shown in figures 2 or 3 of the accompanying drawings.

10

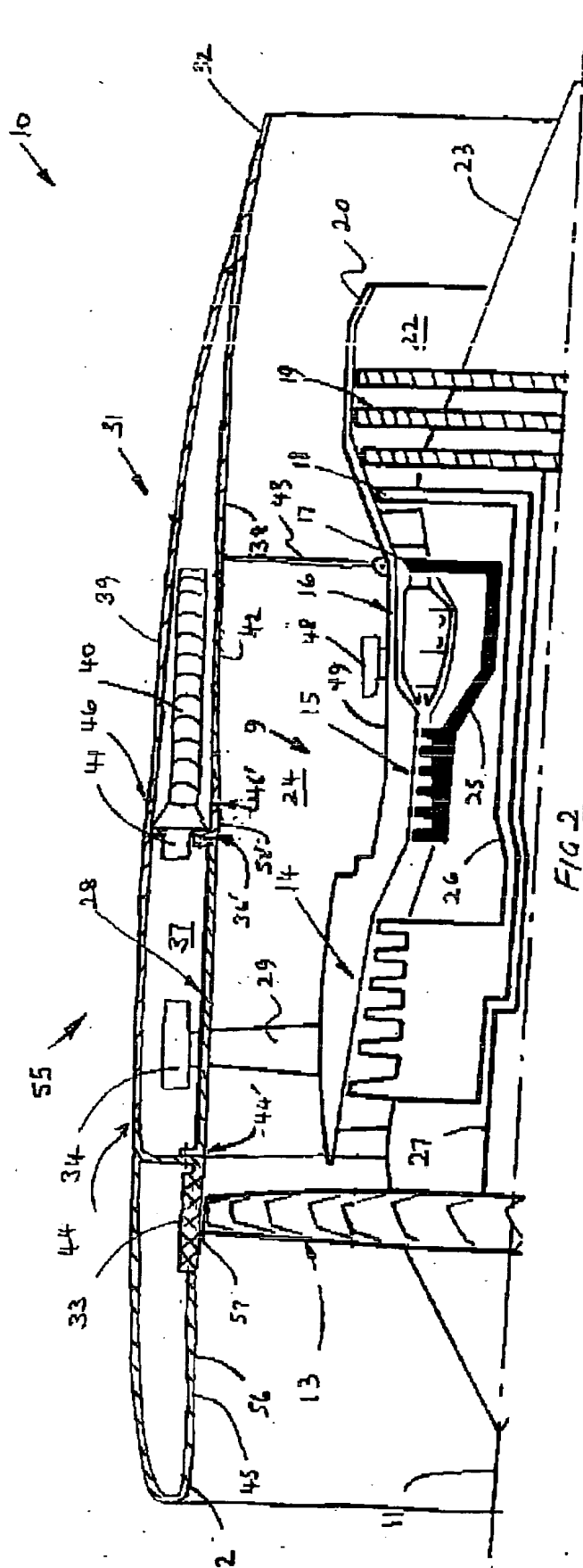
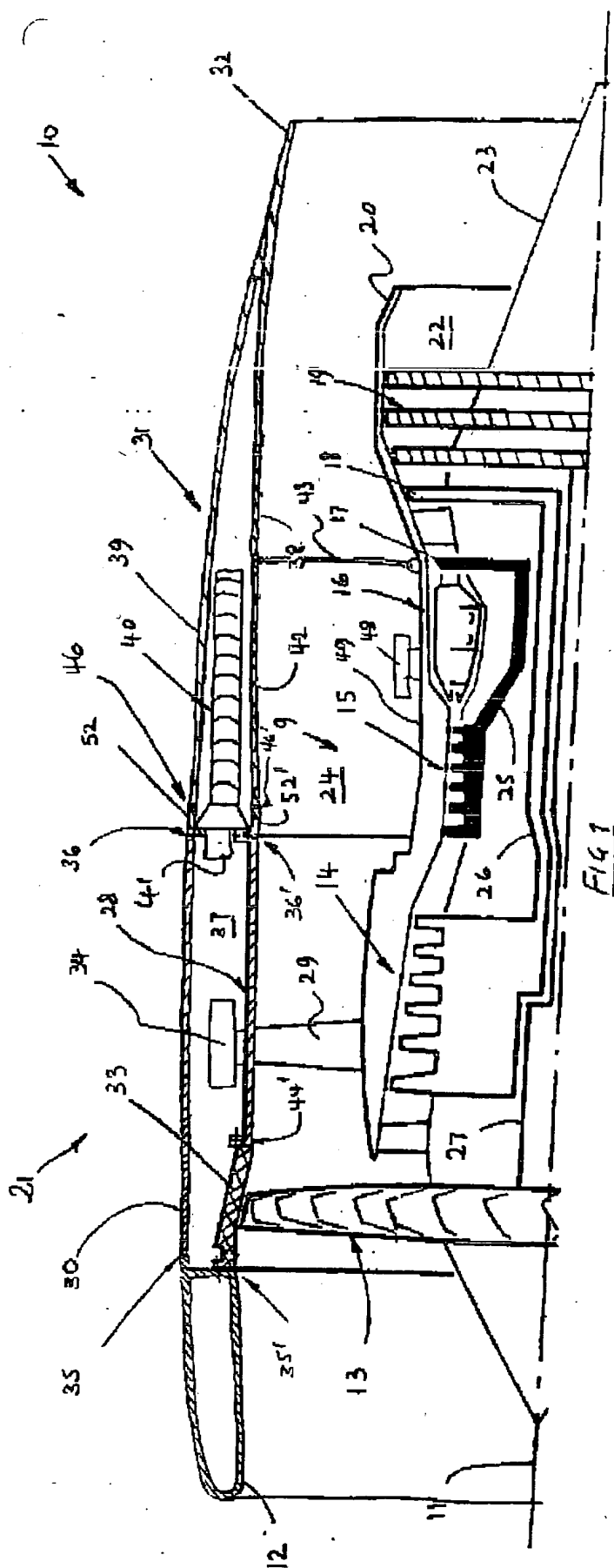
ABSTRACTAEROENGINE NACELLE

5 A nacelle (55) for a gas turbine engine (10), the engine
(10) comprising accessories (34) mounted to a fan casing
(28) and a core engine (9), the nacelle (55) substantially
surrounds the engine (10) and comprises an intake (12) and
a thrust reverser unit (31). The thrust reverser unit (31)
10 is formed by two generally C-shaped portions 31a, 31b. The
thrust reverser unit (31) is openable to provide access to
the accessories (34) and the core engine (9). The nacelle
(55) further comprises a fan containment casing (33) that
is integral with the intake (12).

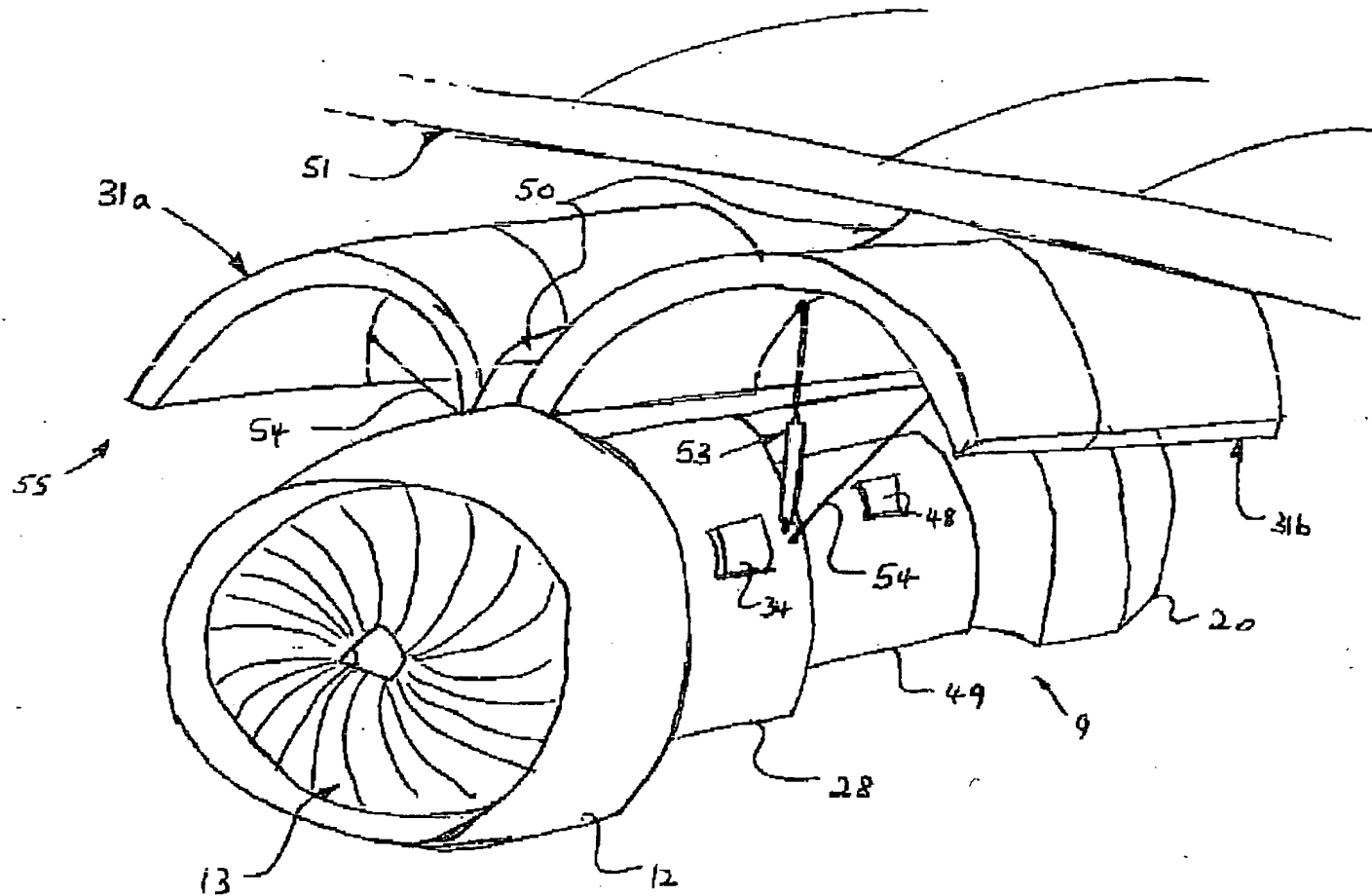
15

(Figure 2)

THIS PAGE BLANK (USPTO)



THIS PAGE BLANK (USPTO)

FIG 3

THIS PAGE BLANK (USPTO)

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.

THIS PAGE BLANK (USPTO)